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Perceptions of safety management and safety culture in the aviation industry in New Zealand

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Abstract

This paper uses industry wide survey data to assess employees' perceptions of safety management and safety culture in the aviation industry. Results show that organisations, in ensuring safety, considered employees' safety responsibilities to be more important than implementing effective safety management systems and encouraging positive safety culture. Aircraft maintenance engineers appeared to be committed to standards and operating procedures and effective organisational processes in making the maintenance system work. Interestingly, pilots regarded luck to be a significant contributing factor in safety. Overall, the findings suggest the various sectors of the aviation industry need to do much more to improve the prevailing safety culture.

Keywords: Aviation; Safety culture; Organisational processes; Luck and safety

1. Introduction

Aviation industry, in many ways, being similar to other high-tech, high risk, and tightly coupled organisations works with the view that 'accidents are inevitable' (Perrow, 1984). Accident investigation reports in the 1980s and 1990s provided the impetus for links between organisation's safety management processes and accidents (Report of the Royal Commission, 1981; Vette, 1983; Moshansky, 1992). For example, the National Transportation Safety Board (NTSB) in its report on the accident of Continental Express Embraer 120 asserted that the lax attitude in the hanger suggests that management did not establish an effective safety orientation for its employees (National Transportation Safety Board, 1992). Thus highlighting the need to research, parallel to human error, other systemic factors that contribute to incidents and accidents.

Organisational practices affecting the performance and reliability of safety systems are the ways in which safety is managed in aviation organisations: leading to either 'good' or 'lax' safety culture (Reason, 1993, 1997). Aspects of safety culture are found in the shared attitudes of care and concern throughout the organisation (Pidgeon and O'Leary, 1995), and in the visible commitment of senior management to safety (Droste, 1997). It is also located in an atmosphere that thrives on sharing vital information—'informed culture', where employees are prepared to report their errors and near-misses—'reporting culture', and have the trust that they will be treated fairly—'just culture' (Reason, 1998).

2. Safety management systems and safety culture

Aviation organisations design safety management systems with the view that there will always be threats to safety: an essential component of ensuring safety is about identifying and managing threats before accidents occur. The effectiveness of a safety management system depends on how well it permeates in the fabric of the organisation—'the ways in which things are done'—so that a positive safety culture is generated and maintained in an ongoing manner.

The relationship between safety management systems, and safety culture has been discussed extensively in the safety literature of high-tech and high-risk endeavours including aviation. Regulatory authorities are also taking a keen interest in the role played by safety management systems, and safety culture in ensuring safety. For example, Civil Aviation Authority, United

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Kingdom (2002), recognises the value of safety management system as 'the systematic management of the risks associated with flight operations, related ground operations and aircraft engineering or maintenance activities to achieve high levels of safety performance'. Similarly, Civil Aviation Authority of New Zealand is taking steps to enhance safety in the industry, as a result of issues raised at both 2001 and 2002 'Towards 2005' safety forums.

This paper reports the findings of an industry wide study carried out to construct a broad view on how safety is managed in the aviation industry (Gill, 2001). It does not provide a detailed description of activities pertaining to technical aspects of aviation safety, but presents an overview of organisational processes affecting safety. The specific objectives are to assess organisations' approach to safety management; and to assess safety management systems, and safety culture in organisations.

3. Methodology

Considering the complexities of measuring safety management in the aviation sector, a pilot study in a flight training facility in New Zealand was conducted to develop and test a safety assessment questionnaire. The methodologies employed in the pilot study ranged from focus group and personal interviews, content analysis of the concerned organisation's safety manuals and safety audit reports. In addition, literature search using publications of Civil Aviation Authority of New Zealand, seminars and speeches of industry professionals, and academic publications in the area of aviation safety and safety culture, was carried out. The gathered information was used to develop a safety assessment questionnaire that included aspects of organisations' approach to safety management, safety management systems, and safety culture. The questionnaire was tested in the flight training facility. Out of 68 items in the questionnaire, 16 were eliminated due to nonapplicability in the aviation context, low response rate, shared similarity in meaning within items, and lack of relevance to safety assessment. The remaining 52 items characterised management of safety in the context of aviation sector.

The full survey questionnaire included 52 items, selected from the pilot study, that were divided into two sets: 'organisations' approach to safety management' (26 items) and 'safety management systems, and safety culture in organisations' (26 items). The main focus of the set of items on organisations' approach to safety management was to capture respondents' perception regarding the role played by their employer corporation/organisation, as an entity, in ensuring safety. Similarly, the second set of items sought respondents' perceptions on the prevailing safety related attitudes and beliefs and the ways in which safety is managed in their employer organisations.

Table 1
Breakdown of respondents in the survey by core business and position in organisation

Core business of respondents	*Frequency*	*Percent*
Air transport/Airline	147	31.7
Maintenance engineering	63	13.6
Flight training	52	11.2
Airport/aerodrome	8	1.7
Helicopter operations	30	6.5
Quality assurance/Safety education/exams	6	1.3
Other-air traffic control[a] & general aviation	158	34.1
Total	464	100.0
Respondents' position in organisation	*Frequency*	*Percent*
Pilot	172	37.1
Maintenance engineer	74	15.9
Flight training instructor	40	8.6
Manager	88	19.0
Personnel, quality assurance/safety education/exams	20	4.3
Other-air traffic controller & general aviation personnel	70	15.1
Total	464	100.0

[a] Category Air Traffic Control was combined with General Aviation to preserve confidentiality.

The survey was administered through CAA News, safety magazine of Civil Aviation Authority of New Zealand, to its entire distribution list[1] of 13 500 aviation businesses and individuals throughout the aviation industry in New Zealand. Five hundred completed questionnaires were received, out of which 36 were unusable. The findings are based on 464 questionnaires that were considered complete and valid. Although the response rate is low, the sample is representative of almost the entire population of personnel within the aviation industry in New Zealand. The respondents represented almost all sectors of the aviation industry (Table 1).

4. Results

The first section on respondents' perception of organisations' approach to safety management included 26 items. The second section on respondents' views on safety management systems, and safety culture in organisations also included 26 items. Both sets were

[1] Distribution list in comprised of all New Zealand Flight Crew, Air Traffic Controllers, Aircraft Maintenance Engineer licence holders aircraft owners, most organisations holding an aviation Document, and certain other persons and orgainsations interested in promoting safer aviation.

tested on a 5-point scale where 1 = strongly disagree and 5 = strongly agree.

A factor analysis with varimax rotation was used on both sets of 26 Likert-type items each in order to clarify the underlying structure of the data. The Cronbach's Alpha was 0.933 and 0.922, Kaiser–Meyer–Olkin measure of sampling adequacy was 0.948 and 0.947 and Bartlett's test of Sphericity was significant in both sets of data, indicating that it was appropriate to apply the factor analytical technique to these data sets.

The initial factor solution identified four factors from each data set, based on the pattern of the scree plot and the decision rule that eigen values should be greater than or equal to one. Two criteria were applied to determine whether the factors were of practical value: individual item factor loading had to exceed 0.4, and if any variable is loading significantly on more than one factor then that variable was included in the factor with the highest loading.

Section one of questionnaire explored respondents' views about their organisation's approach to safety management. Several variables were obtained from relevant literature to determine organisations' best practices to manage safety. These best practices were piloted to optimise an assessment scale of 26 variables.

Four factors were extracted through the factor analysis from the variables (Table 2). The first factor loaded heavily on first 11 variables-this factor might be labelled as 'positive safety practices'. This factor alone has explained nearly four–fifth of the total variation in this factor solution. The second factor correlated most highly with the next 6 variables—this factor might be called 'safety education'. This factor indicates that provision of safety education is essential in ensuring safety. The third factor can be labelled as 'implementation of safety policies and procedures' because it loaded high on the next 7 variables representing safety policies and procedures as methods of ensuring safety. The

Table 2
Results of factor analysis of data related to organisations' approach to safety management

Variables	Factors				
	Your organisation…	1	2	3	4
v6	Takes everyone's safety seriously for whom it is responsible as a document holder.	*0.579*	0.329	0.445	−0.096
v7	Considers safety-related paperwork essential to ensure everyone's safety.	*0.501*	0.220	0.432	0.068
v8	Enforces its safety policies and procedures effectively.	*0.629*	0.433	0.358	−0.089
v10	Praises those who raise safety concerns.	*0.623*	0.334	0.260	−0.201
v11	Has a safety officer at hand if and when needed.	*0.453*	0.396	0.359	−0.131
v12	Takes disciplinary action for non-compliance.	*0.539*	0.351	−0.056	0.163
v13	Provides adequate resources to ensure safety policy and procedures are followed.	*0.562*	0.368	0.420	−0.125
v14	Promotes safety through managers/supervisors leading by example.	*0.656*	0.411	0.271	−0.113
v16	Takes action on the reported safety concerns.	*0.682*	0.192	0.375	−0.148
v17	Supports staff when they report a situation that can lead to danger.	*0.648*	0.235	0.399	−0.238
v18	Considers itself to be responsible for the safety of its employees and clients.	*0.633*	0.076	0.281	−0.083
v20	Ensures that staff attend safety courses and seminars.	0.160	*0.758*	0.320	−0.071
v21	Has in-house safety education Programme/s.	0.090	*0.742*	0.403	0.012
v22	Ensures all staff are current with regard to safety rules and procedures.	0.368	*0.704*	0.277	−0.026
v23	Educates staff about the benefits and costs of safety and accidents.	0.317	*0.729*	0.197	0.001
v24	Allows you to practice what you have learned in safety courses and seminars.	0.394	*0.681*	0.194	−0.107
v25	Considers safety education to be an important part of ensuring safety.	0.518	*0.640*	0.196	−0.170
v1	Has incident/accident investigation methods in place.	0.134	0.165	*0.783*	0.044
v2	Has safety instructions that are easy to follow.	0.271	0.314	*0.625*	−0.081
v3	Has a system in place whereby staff can report incidents anonymously.	0.173	0.249	*0.461*	−0.073
v4	Has a safety policy that is non-punitive.	0.294	0.110	*0.619*	−0.250
v5	Has a practicable safety policy understood by all.	0.368	0.363	*0.589*	−0.07
v9	Carries out internal safety audit periodically.	0.198	0.235	*0.582*	0.012
v15	Has a position on 'safety at a reasonable cost' when making crucial decisions.	0.340	0.103	*0.440*	0.080
v19	Takes the view that it is up to the individual to ensure own safety.	−0.147	0.078	−0.005	*0.833*
v26	Considers safety education to be individual staff's responsibility.	−0.047	−0.199	−0.042	*0.845*
	Variation explained by each factor				
	Mean of Factor items	44.90%	6.26%	5.17%	3.96%
Total variation explained by these factors		60.29%			
Cronbach's alpha		0.9335			
Kaiser–Meyer–Olkin measure of sampling adequacy		0.948			
Bartlett's tests of sphericity:					
Approx. chi-square		5629.137			
Df		325			
Significance		0.000			

Table 3
Means and standard deviations of factors related to organisations' approach to safety management

Factors	Means	Standard deviations
Positive safety practices	2.24	0.83
Safety education	2.43	0.92
Implementation of safety policies and procedures	2.22	0.72
Individual's safety responsibilities	*2.95*	1.05

fourth factor, including the last two variables, can be named as 'individual's safety responsibilities' as it reflected individual's obligation and contribution to safety. These four factors accounted for 60.29% of the variance as shown in Table 2.

The means of factors to the first set of analysis of data indicate that respondents think that their employers regard 'individual's safety responsibilities' (2.95) to be more important in safety management than other factors identified in Table 3. Although the scale to assess organisations' approach to safety management was developed and optimised through pilot study, the relative importance of factors may be attributed to the nature of questions and the wording of statements in the questionnaire (Table 2). Considering this, it seems respondents' organisations regard individuals' accountability to safety more important than instilling positive safety practices and implementing safety policies and procedures. Contrary to this, accident reports indicate that individuals' and organisations' contribution to safety cannot be separated as accidents result from the combined effect of long term standing conditions—such as organisational culture, working practices, customs and attitudes and isolated unsafe acts by individuals (Andersen and Wreathall, 1990; Maurino, 1992).

'Safety education' factor was ranked number 2 (2.43), indicating that this factor is considered to be very important in enhancing safety. Considering the first two factors it appears that organisations are perceived to value the role of safety education in safety and therefore make it available through a variety of means. However, they take the view that it is employees' responsibility to access it and to use it to ensure own safety in operations.

Respondents perceived that their organisations, relatively, gave a low importance to implementation of safety policies and procedures and positive safety practices. This may be because organisations take the view that employees should practice safety as part of working in the aviation sector. If this assumption is true then there is a danger in employers becoming complacent in monitoring safety activities. The variables incorporated in these two factors reflect safety practices such as resource allocation, risk management, and monitoring and reviewing safety practices in operations. Considering that respondents viewed these factors (18 variables) to have been given a low importance by their employer, it shows that not enough is being done to ensure safety at strategic level (Pidgeon and O'Leary, 1995), and that organisations may be vulnerable to both active and latent failures (Reason, 1990).

4.1. Factors related to organisations' approach to safety management and core business and position of respondents

Considering respondents' core business and relative importance given to the four factors, aircraft maintenance engineering businesses are noted to consider 'positive safety practices' and 'safety education' as the two most important factors in ensuring safety. Similarly, considering the position of respondents and the four factors it shows that aircraft maintenance engineers perceived that their employers considered positive safety practices, safety education, and implementation of safety policies and procedures to be the most important aspects in ensuring safety in the maintenance system. Considering this, maintenance engineers standout amongst their colleagues in the aviation industry in that their organisations are perceived to be giving more importance to implementation of safety policies and procedures, positive safety practices, and safety education in ensuring safety than other sectors. A sub-culture appears to have emerged amongst aircraft maintenance engineers that is committed to ensuring safety by strongly following standards and regulatory procedures and safety practices. This is a positive finding, given that 12% of major aviation accidents are caused by inspection and maintenance inadequacies (Marx and Graeber, 1994), and that the number of maintenance-related accidents is on the increase (King, 1998).

Air traffic controllers and personnel in general aviation perceived that their organisations placed more importance on individual's responsibility to safety than any other factor. This may be because air traffic controllers and pilots' decision-making depends upon information received in written, aural, or visual form requiring a high level of judgement that often leaves them vulnerable to errors despite a high degree of training (Shouksmith, 1990; Maurino et al., 1995).

Section two of questionnaire explored respondents' views about safety management systems and safety culture in their organisations. Several variables obtained from literature relevant to safety management systems and positive safety culture in organisations were piloted to optimise a scale of 26 variables. Table 4 shows the factor solution of these variables and highlights 4 factors from the list of 26 variables. Factor 1 loaded high on first 16 variables that represent respondents' views about the ways in which safety is managed in their organisations. This factor can be named as 'organisational

Table 4
Factor analysis of data related to safety management systems, and safety culture in organisations

Variables	Factors				
	In your organisation…	1	2	3	4
v1	There is an open communication between management and staff about safety issues.	*0.829*	−0.031	−0.062	0.042
v2	Management usually informs staff of incidents and their outcomes.	*0.699*	−0.063	−0.086	0.258
v3	Safety information is brought to staff's attention by their managers/supervisors.	*0.770*	−0.024	−0.021	0.244
v4	Management takes a personal interest in safety compliance	*0.840*	0.066	0.008	0.147
v5	Even due to financial pressures, safety takes priority.	*0.850*	0.053	−0.056	−0.025
v6	If employee safety is at risk, managers halt operations.	*0.819*	0.089	−0.013	−0.075
v7	Even if it means lost revenue, the management does not expect staff to ignore safety.	*0.844*	0.016	−0.040	0.064
v8	Management encourages fearless reporting of incidents, errors, and safety concerns	*0.807*	0.162	0.066	0.103
v10	Managers have open discussion with employees about safety issues.	*0.800*	−0.053	0.042	0.167
v11	Staff does not risk their jobs when they report safety concerns to management.	*0.795*	0.165	−0.018	−0.037
v15	The knowledge gained from incident reviews is usually put into practice.	*0.622*	0.253	0.004	0.199
v17	Management allocates resources to meet safety needs.	*0.759*	0.100	−0.114	0.169
v18	Management knows what goes on in operations.	*0.733*	0.147	−0.023	0.124
v19	Management does something about hazards before accidents can occur.	*0.786*	0.136	−0.081	0.098
v21	Most staff receives adequate initial training to confidently do the job.	*0.662*	0.152	0.107	0.316
v23	Staff does not face reprisal for raising safety issues.	*0.815*	0.161	−0.006	−0.075
v12	The regulator's (CAA) rules and policies are clear and simple to follow.	0.054	0.821	0.033	0.016
v13	CAA's audits are useful in ensuring safety.	0.103	0.757	0.050	0.099
v14	You are clear about the difference in CAA's safety and enforcement roles.	0.092	0.723	−0.198	0.043
v22	You believe accidents will happen no matter what anyone does.	0.096	0.026	*0.780*	−0.040
v24	Staff believes that luck plays a major role in aviation safety.	−0.266	−0.131	*0.638*	0.198
v25	You believe everyone is likely to have an accident sooner or later.	0.006	−0.026	*0.830*	−0.157
v9	Management takes disciplinary action against staff for regulatory noncompliance.	0.387	0.070	0.175	*0.427*
v16	You have up-to-date software/technology to manage safety systems.	0.362	0.226	−0.015	*0.575*
v20	Pilots/engineers receive recurrent training.	0.518	0.083	−0.043	*0.563*
v26	Judgement of 'safety at a reasonable cost' does not put people at risk.	0.365	0.060	0.196	*−0.489*
	Variation explained by each factor mean of factor items	42.52%	7.71%	6.74%	4.63%
Total variation explained by these factors		61.60%			
Cronbach's alpha		0.9226			
Kaiser–Meyer–Olkin measure of sampling adequacy		0.947			
Bartlett's tests of sphericity:					
Approx. chi-square		5446.387			
Df		325			
Significance		0.000			

dynamics and positive safety practices'. This factor alone has explained $\frac{3}{4}$ of the total variation explained by this factor solution. The second factor loaded high on the next 3 variables that can be termed as 'regulator's role'. Factor 3, loading high on the next 3 variables, can be labelled 'luck and safety'. Finally, factor 4, including the last 4 variables, can be named as 'safety management, training, and decision-making'. The factor analysis of second set of data accounted for 61.60% of the explained variance as shown in Table 4.

Means of factors to the second set of data analysis show that respondents perceive 'luck and safety' (3.82) as the most important factor indicating attitudes and beliefs play a vital role in safety in the aviation industry (Table 5). Respondents ranked 'regulator's role' as number 2 (2.89) indicating the importance of CAA's role in ensuring safety. Although the scale to assess safety management systems and safety culture in organisations was developed and optimised through pilot study, the relative importance of factors may be attributed to the nature of questions and the wording of statements in the questionnaire (see Table 4).

It is interesting that respondents consider luck and safety more important than training and organisational dynamics and positive safety practices. Luck and safety reflects attitudes and beliefs about safety and whether or not one has control over it. This factor structure shares similarity with other researchers' findings such as 'fatalism' (Williamson et al., 1997) and 'personal scepticism' (Cox and Cox, 1991). Interestingly, considering factors on safety management systems, and safety culture (Table 5) and respondents' position in organisations 'pilots' perceive luck and safety to be the most important factor in aviation safety.

It is noted that pilots believe 'accidents will happen no matter what anyone does', 'everyone is likely to have an accident sooner or later', and that 'luck plays a major role in aviation'. This finding shares similarity in the Australian context and thereby generates similar safety concerns in that 'when safety culture shifts from one

Table 5
Means and standard deviations of factors related to safety management systems, and safety culture in organisations

Factors	Means	Standard deviations
Organisational dynamics & positive safety practices	2.21	0.88
Regulator's role	2.89	0.87
Luck and safety	*3.82*	0.87
Safety management, training and decision-making	2.70	0.73

that believes it can prevent accidents to one which accepts them to be inevitable, so the risk of them occurring will increase' (Braithwaite et al., 1998). Further research is needed to establish whether this finding indicates pilots' lack of confidence in the safety delivery system or depicts professional reality of working within an environment that has tightly coupled interactive systems (Perrow, 1984) and is vulnerable to organisational accidents (Reason, 1990).

The second strongest factor selected was 'regulator's role' suggesting that organisations in the aviation industry are perceived to be dependent on the Civil Aviation Authority of New Zealand (CAA) with regard to ensuring safety. The CAA establishes civil aviation safety and security standards, and monitors adherence to those standards, as well as provide search and rescue services throughout New Zealand and the South Pacific (Civil Aviation Authority of New Zealand, 1999). It is also responsible for carrying out incident and accident investigations that forms the basis of industry-wide safety education (Civil Aviation Authority of New Zealand, 2000). Respondents perceived CAA's contribution and involvement to be imperative, especially with regard to aviation rules and policies, auditing, and its role as an educator and regulator in ensuring safety in the industry.

The third strongest factor selected was 'safety management, training, and decision-making'. It is interesting to note that respondents did not perceive that this factor was given much importance in their organisations. In other words, in aviation industry, there is not much emphasis on recurrent training and the use of up-to-date technology to manage safety systems. This may be because safety comes at a cost, and that the resources required for training and development, and managing safety information might be scarce. The variable inquiring into organisation's position on 'safety at a reasonable cost' may have been perceived as confusing and unclear.

'Organisational dynamics & positive safety practices' was perceived to be the weakest factor. Apparently, this factor incorporated 16 variables. It suggests that in aviation, employers do not consider safety-related interactions, activities, and practices to be of very much importance in safety. The variables included in this factor are somewhat similar to the items contained in safety culture analysis by Pidgeon and O'Leary, (1995), organisational functions required in effective safety management by Health and Safety Executive (1991), and safety climate scale developed by Williamson et al. (1997). In view of the contents of this factor, it appears that organisations may be compromising safety by not regarding safety management systems and safety cultural processes to be necessary in ensuring safety. This finding is consistent with earlier observation that employers do not give much weight to positive safety practices and implementation of safety policies and procedures (Table 3).

Considering respondents' position and the four factors it is worth noting that aircraft maintenance engineers considered organisational dynamics and safety management systems and safety management training and decision-making to be important factors in ensuring safety. Similarly, considering respondents' core business and the four factors, it is evident that aircraft maintenance engineering sector is perceived to consider organisational dynamics and safety management systems and safety management training, and decision-making to be critical components in ensuring safety in their kind of work. In sum, employees from aircraft maintenance engineering regarded organisational dynamics and safety management systems to be highly significant in ensuring safety.

5. Conclusions

This study reported employees' perceptions of safety management and safety culture in the aviation industry based on two sets of data: organisations' approach to safety management (26 variables) and safety management systems, and safety culture in organisations (26 variables). To assess management of safety in aviation organisations, an assessment scale was developed and optimised through a pilot study for each set of data. Both sets of data were subjected to factor analysis and the results appeared to have acceptable internal consistency.

An interesting finding of this study is that pilots perceived 'luck and safety' to be the most important factor in aviation safety. Staff working in quality assurance, safety education, and examinations also shared this view. This aspect needs to be further researched to establish whether there is a lack of confidence in the safety delivery system or that employees just work with the knowledge that safety in aviation depends on good/bad luck.

A major finding of this study is that employers are not perceived to be giving much importance to safety

management systems, and safety culture in aviation organisations. Especially the airport sector and air traffic control and general aviation sector: they were perceived to regard individual's responsibility to safety more important than safety education, positive safety practices, and implementation of safety policies and procedures. Further, the findings show that aviation organisations do not regard safety management, training and decision-making to be of much importance in ensuring safety. This may be less desirable because of a lack of resources to fund such activities and promote a positive safety culture. In fact, other than in aircraft maintenance engineering organisations, safety management systems, and safety culture is not given much importance.

Another significant revelation is that neither employers give much importance to safety related processes, activities and systems such as recurrent training, having up-to-date technology to manage safety information, nor do they have a position on the idea of 'safety at a reasonable cost'. However, New Zealand CAA's involvement, especially with regard to aviation rules and policies, auditing, and its role as an educator and regulator, was considered imperative.

Finally, this study has provided an overview on employees' perceptions on how safety is managed in the aviation industry. Based on the findings, it is concluded that organisations in the various sectors of the industry could do better in managing safety, and improve the safety culture in the industry. It is recommended that the various sectors work in partnership with the authority (CAA) to improve safety in the industry. At another level, further research is required to dig deeper into some of the issues raised in this study.

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References

Andersen, N.S., Wreathall, J., 1990. A structure of influences on management and organisational factors on unsafe acts at the job performer level. Proceedings of the Human Factors Society, 34th Annual Meeting, London.

Braithwaite, G.R., Caves, R.E., Faulkner, J.P.E., 1998. Australian aviation safety—observations from the 'lucky' country. Journal of Air Transport Management 4, 55–62.

Civil Aviation Authority of New Zealand, 1999. Aviation safety regulation—a decade of change. Civil Aviation Authority of New Zealand, Lower Hutt.

Civil Aviation Authority of New Zealand, 2000. Profile 2000: safety in partnership with the aviation industry for New Zealanders. Civil Aviation Authority of New Zealand, Lower Hutt.

Civil Aviation Authority of United Kingdom, 2002. Safety Management Systems for Commercial Air Transport Operations, www.caa.co.uk.

Cox, S., Cox, T., 1991. The structure of employee attitudes to safety: a European example. Work and Stress 5, 93–106.

Droste, B.A.C., 1997. Aviation safety management in Royal Netherlands air force. In: Soekkha, H.M. (Ed.), Proceedings of the IASC-1997, VPS, Amsterdam.

Gill, G.K., 2001. Safety Culture in Aviation Organisations in New Zealand (Plenary Speaker) 21–22 October, Towards 2005, Implementing Solutions, Wellington.

Health and Safety Executive, 1991. Successful Health and Safety Management. Health and Safety Executive. HMSO, London.

King, D.F., 1998. Learning lessons the (not quite so) hard way incidents, the route to human factors in engineering. In: Belton, F. (Ed.), on human factors in aviation maintenance, Proceedings of a Symposium in Gatwick Airport, CAA, London.

Marx, D.A., Graeber, C.A., 1994. Human factors in aircraft maintenance. In: Johnson, N., Fuller, R., McDonald, N. (Eds.), Aviation Psychology in Practice, Avebury Technical, Aldershot.

Maurino, D.E., 1992. Corporate culture imposes significant influence on safety. International Civil Organisational Journal, April.

Maurino, D.E., Reason, R., Johnston, N., Lee, R.B., 1995. Beyond Aviation Human Factors. England: Ashgate Publishing.

Moshansky, V.P., 1992. Commission of inquiry into the air Ontario crash at Dryden, Ontario. Final Report, Ottawa.

National Transportation Safety Board, 1992. Aircraft Accident Report: Continental Express Flight 2574 In-flight Structural Breakup, EMB-120RT, N33701, Eagle Lake, Texas (NTSB/AAR-92/04), National Transportation Safety Board, Washington DC.

Perrow, C., 1984. Normal Accidents. Basic Books, New York.

Pidgeon, N., O'Leary, M., 1995. Organisational Safety Culture: Implications for aviation practice. In: McDonald, N., Johnston, N., Fuller, R. (Eds.), Application of Psychology to the Aviation System, England: Aubury, pp. 47–52.

Reason, J., 1990. Human Error. Cambridge University Press, New York.

Reason, J., 1993. Human factors in aviation. Proceedings of 22nd IATA Technical Conference, Montreal.

Reason, J., 1997. Managing the Risks of Organisational Accidents. Aldershot.

Reason, J., 1998. Achieving a safe culture: theory and practice. Work and Practice 12, 293–306.

Report of Royal commission to inquire into the crash of Mount Erebus, Antarctica, of a DC10 Aircraft operated by Air New Zealand Limited, 1981, Wellington, New Zealand.

Shouksmith, G., 1990. A study of radar controller workloads and the radar control capacity of the New Zealand ATS system. Prepared under a contract with the Civil Aviation Division of the Ministry of Transport as part of the overall review of air traffic services by the Department of Psychology. Massey University, New Zealand.

Vette, G., 1983. Impact Erebus. Hodder and Stoughton, New Zealand.

Williamson, A.M., Feyer, A., Cairns, D., Biancotti, D., 1997. The development of a measure of safety climate: the role of safety perceptions and attitudes. Safety Science 25, 15–27.